

## CLAIMS

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What is claimed is:

1. An apparatus for canceling an image signal from a received radio frequency signal, the apparatus comprising:

a ring oscillator for producing a radio frequency signal having in-phase and quadrature phase components;

5 a first mixer having inputs configured to receive the in-phase component and the received radio frequency signal and outputting an in-phase signal;

a second mixer having inputs configured to receive the quadrature phase component and the received radio frequency signal and outputting a quadrature phase signal;

a phase shift device coupled with one of the mixers for receiving an output of the one mixer and outputting a phase shifted signal; and

a combiner, operatively coupled to the other of the mixers and said phase shift device, for producing an image cancelled signal.

2. The apparatus of claim 1 wherein the phase shift device is coupled to the second mixer.

3. The apparatus of claim 2 wherein the phase shift device shifts a phase of the second mixer output by ninety degrees.

4. The apparatus of claim 1 wherein the ring oscillator comprises four delay cells, an output of each delay cell is coupled to an output of another of the delay cells.

5. The apparatus of claim 4 wherein each delay cell delays its input by forty-five degrees and one of the couplings is cross-coupled so that the output of one of the delay cells is inverted prior to input into another of the delay cells.

6. The apparatus of claim 1 wherein the first mixer and the second mixer are gilbert cells.

7. A receiver for use in a wideband communication system, the receiver capable of canceling an image signal from a received radio frequency signal, the receiver comprising:

5 a ring oscillator for producing a radio frequency signal having in-phase and quadrature phase components;

first mixing means for mixing the in-phase component with the received radio frequency signal and outputting an in-phase signal;

second mixing means for mixing the quadrature phase component with the received radio frequency signal and outputting a quadrature phase signal;

means for receiving one of the mixer's phase signals and outputting a phase shifted signal; and

means for combining the phase shifted signal with the phase signal other than the one phase signal to produce an image canceled signal.

8. The receiver of claim 7 wherein the means for outputting a phase shifted signal shifts the one phase signal by ninety degrees in phase.

9. The receiver of claim 7 wherein the ring oscillator comprises four delay cells, an input of each delay cell is coupled to an output of another of the delay cells.

10. The receiver of claim 9 wherein each delay cell delays its input by forty-five degrees and one of the couplings is cross-coupled so that the output of the delay cell is inverted prior to input into another of the delay cells.

11. The receiver of claim 7 wherein the means for outputting a phase shift signal is coupled to the first mixing means.

12. The receiver of claim 7 wherein the first and second mixing means comprises a gilbert cell.

13. A method for canceling an image signal from a received radio frequency signal, the method comprising:

providing a ring oscillator;

5 producing a radio frequency signal having in-phase and quadrature phase components with the ring oscillator;

mixing the in-phase component and the received radio frequency signal to produce an in-phase signal;

mixing the quadrature phase component and the received radio frequency signal to produce a quadrature phase signal;

shifting a phase of one of the phase signals produced by mixing the components to produce a phase shifted signal; and

combining the phase shifted signal with the phase signal produced by mixing the components other than the one phase signal to produce an image canceled signal.

14. The method of claim 13 wherein the one phase signal is the quadrature phase signal.

15. The method of claim 13 wherein the phase shifting is by ninety degrees in phase.